names of Redfern, Carter, and Dobie, who have each made their mark in this branch of science. It was not, however, until the early sixties that practical physiology, as now understood, was developed in the Edinburgh school. Bennett's great contemporary, John Goodsir, the anatomist, brought under his notice the new experimental school of Germany, and in a short time the ingenious instruments of Helmholtz, Du Bois-Reymond, and Ludwig made their appearance in Edinburgh, probably before they were known in any other school in Great Britain. The first assistant who dealt with such matters, and who added a short course of instruction in physiological chemistry, was Dr. Argyll Robertson, the eminent ophthalmologist. After him came Rutherford, who threw himself into the work with characteristic ardour, and who amplified the course from year to year. In 1869, he became Professor of Physiology in King's College, London; in 1871, Professor of Physiology in the Royal Institution of Great Britain; and, in 1874, he returned to Edinburgh to occupy the chair of his old master. For twenty-five years he laboured unremittingly as a teacher, and he was able, as few men could have done, to cope with the enormous classes which for several years characterised the Edinburgh school. During the winter session, the systematic class frequently numbered five hundred students, while about two hundred and fifty obtained instruction in practical physiology, partly in the winter but mostly in the summer session.

It has always been the tradition that the occupant of a Scottish chair is expected to do two things: he must, in the first place, be a successful teacher, and, in the next, he must contribute to scientific progress; and it may be at once said that many eminent men have not found the two classes of duties to be incompatible. Rutherford is a typical example of such a successful combination, although, no doubt, he will be best remembered as a teacher. In this department of his work he was indeed a master. No one understood better the arts of clear exposition and of successful demonstration. It may be said his lectures were demonstrations from beginning to end. He devised ingenious methods by which fundamental phenomena might be successfully shown to large numbers of students, and his lectures were always copiously illustrated by diagrams. He did not trust much to text-books, nor to students finding out for themselves by laboratory work. He believed that the average student requires to be guided; that he must have the subject placed before him in such a way that he can grasp its leading principles; and that, without careful supervision and almost elementary drill, he will probably lose time in bungling laboratory work. Rutherford, therefore, took immense pains in leading the student on step by step, both in systematic teaching and in the laboratory. It is probable that from the highest point of view he erred in his method, or, rather, carried it too far, but he was eminently successful in training the average man.

Recognising that physiology is a composite science, a science that rests on the triple foundation of anatomy, physics, and chemistry, his own predilections were towards the first. He was thoroughly conversant with histology, as a branch of anatomy, and in his lectures perhaps undue prominence was given to this subject. He spent more time than was necessary in minute morphological details, with the physiological significance of which he was unacquainted; but he held that physiology must begin with an intimate knowledge of the structure of the cell and of the fibre. In this he was right. Histology, for ordinary students, must be taught from the physiological standpoint, but it is high time that the physiologist was relieved from teaching the technique of the subject. Rutherford's earlier training prevented him from grasping with equal firmness the applications of chemistry and physics to physiological problems. Here he was not so much at home. It only remains to be said that, taking him all round, he was one of the most successful teachers that ever adorned the northern school.

As an original investigator, Rutherford accomplished not a little, although it must be admitted that the time he devoted to teaching was often at the expense of that which might have been given to original work. It is also too true that when we sum up a man's work, as a rule it seems insignificant. Even the most skilled and diligent labourers lay only a few stones in the building of the temple. Rutherford did good service to histology by the invention of the freezing microtome, an instrument, however, that has served its day, and, except for special work, must give place to more modern and better methods. In his earlier years he paid much attention to electro-physiology, expounded electrotonus, and discussed various points connected with the excitability of nerve. One of his most important communications was made in 1870, on the influence of the vagus on the circulation. From 1872 to 1879 he laboured much on the physiological action of drugs on the secretion of bile, an investigation originated during Bennett's life-time, and then carried on largely by Rutherford and Dr. Arthur Gamgee. Rutherford, in his later researches, and assisted by a young Frenchman, William Vignal, went over the old ground, and extended its area. He investigated the subject by a most laborious and troublesome method, and no doubt laid solid foundations for our knowledge of the actions of various substances on the formation of bile. This work, owing largely to the unreasonable criticisms of those who objected to observations on animals, was the cause of much annoyance and worry, embittering for a time his social life, while it did not bring to him the credit that subsequent years will show it deserved.

In his later years, Rutherford expounded a theory of muscular contraction that has excited not a little attention, and given rise to much criticism. He was also much interested in the question of the functions of the cochlea in the appreciation of tone, and he advanced the "telephone" theory in opposition to the analytic theory of Helmholtz. Latterly he had grave doubts of the accuracy of Johannes Müller's doctrine of the specific energy of nerves, and had he lived he would probably have written on this subject.

Rutherford was a man of strong personal characteristics. A mannerism impossible to describe, acquired in early manhood, became a second nature, and was at first repellent and liable to be misunderstood. If his criticisms were sometimes severe, his scorn of an opponent scathing and bitter, and his assumption of dignity bordering on the grotesque, those who knew something of the inner life were aware that he did good by stealth, and that behind all the formality there was a simple, kindly nature. Animated by a deep love of science, possessed with a sense of duty that was unsparing in its demands on all his energies, imbued with a love of the beautiful that found its delight in painting and music, a warm friend, a stern and unyielding foe, as if some of the blood of the old borderers lingered in his veins, Rutherford was a man who made his mark, and who will not soon be forgotten.

J. G. M.

NOTES.

A FINE monument of Pasteur was unveiled at Lille on April 9. The new buildings of the Pasteur Institute at Lille were opened on the same day.

SIR RICHARD THORNE THORNE, K.C.B., F.R.S., has been elected a member of the Athenæum Club, under the rule which empowers the annual election of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

THE Council of the Iron and Steel Institute has received the intimation that Her Majesty the Queen will be graciously pleased to accept the Gold Medal of the Institute, founded by Sir Henry Bessemer. The first duty of Sir William Roberts-Austen, on taking the chair as president of the Institute on May 4, will be to express the great satisfaction with which this announcement will be received by metallurgists throughout the empire. A main feature of Her Majesty's reign has certainly been the extraordinary development in the production and application of steel.

ACTIVE efforts are being made to secure the establishment of a zoological garden in Edinburgh. The committee that has the matter in hand have decided to approach the Government with a view to ascertaining whether a piece of ground for the proposed garden can be obtained within the Arboretum.

THE relations of the Society of Chemical Industry to chemical engineering and to industrial research will form the subject of an address to be delivered on Monday next by the president of the Society, Mr. George Beilby.

WE regret to see the announcement of the death of Sir William Roberts, F.R.S., the well-known consulting physician. From an obituary notice in the *Times* we learn that he was born on March 18, 1830, and educated at Mill-hill School and at University College, London. He was made a Fellow of the Royal College of Physicians in 1866, when he was selected to deliver the Goulstonian lectures, and he also delivered before that college in the year 1880 the Lumleian lectures, choosing for his subject "The Digestive Ferments and Artificially Digested Food." In continuation of his work in regard to the function of digestion he delivered a series of five lectures at Owens College, Manchester, in 1885, on "Dietetics and Dyspepsia." These two courses of lectures, with other contributions on cognate subjects, he re-issued in a collected form a few years ago in a book entitled "Digestion and Diet." In 1892 he was appointed Croonian Lecturer of the College, and delivered a course of three lectures on the "Chemistry and Therapeutics of Uric Acid, Gravel, and Gout." In 1897 he gave the Harveian oration before the college, delivering an address on "Science and Modern Civilisation," in which he embodied and epitomised the results of the labour and thought of many years. In 1877 he was elected a Fellow of the Royal Society, and in 1879 the Cameron prize was awarded to him by the University of Edinburgh in recognition of the value of his investigations on the subject of the treatment of digestion as a scientific contribution to practical therapeutics. In 1892 he became a member of the Senate of the University of London. He was appointed medical member of the Royal Commission on Opium in 1893, and contributed a memorandum on the general features and the medical aspect of the opium habit in India, which was published as an appendix to the report of the Commission. In 1896 he was appointed to represent the University of London on the General Medical Council. His last official appointment was in connection with the movement to establish a teaching University in London. When by Act of Parliament a statutory commission was appointed to initiate such an institution, he was selected to serve on that commission as representing, with Dr. Michael Foster, the interests of science and medicine.

A MEETING of the Institution of Mechanical Engineers will be held on April 27 and 28. Sir William H. White, K.C.B., F.R.S., president of the Institution, will occupy the chair on both days, and will deliver his address at the first meeting. On April 28, a paper by Mr. H. G. V. Oldham, on evaporation condensers, will be read.

AS already announced, the annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 4 and 5, commencing each day at 10.30 o'clock a.m. The following are the subjects and authors of papers to be read and discussed during the meeting:—The diffusion of iron, Prof. J. O. Arnold and Mr. A. McWilliam; on the Gellivare iron ore mines, Mr. H. Bauerman; the use of blast-furnace and coke-oven gases, Mr. E. Disdier; the Wellman tilting furnace, Mr. A. P. Head; the solution theory of iron and steel, the Baron H. Jüptner von Jonstorff; exploring for iron ore with the magnetic needle, Prof. H. Louis; theories and facts relating to cast iron and steel, Mr. Bertrand S. Summers; the manufacture of steel direct from the ore in the blast furnace, Mr. D. Tschernoff; the use of hot blast in the Bessemer process, Prof. J. Wiborgh.

THE death is announced of Dr. William Frazer, one of the most prominent members of the medical profession in Ireland, and an eminent authority on Irish antiquities.

WE learn from *Science* that the Union Pacific Railway has offered to transport geologists and palæontologists without charge from Chicago or San Francisco to Wyoming, for the purpose of making explorations during the coming summer.

DR. MARTIN, who is now in Siberia investigating the recent reports regarding the fate of the Andrée expedition, has sent Prof. Nordenskjöld a telegram in which he states that they are without foundation.

THE *British Medical Journal* states that the council of the medical faculty of Bucharest has expressed its approval of a scheme for the establishment of a new institute of bacteriology and experimental medicine in that city. It is proposed to place Dr. Cantacuzino, at present assistant in the Institut Pasteur of Paris, at the head of the new institute.

THE Trout Fishing Annual Close Time (Scotland) Bill was read a second time in the House of Lords on Tuesday. The object of the Bill is to establish a close time for trout in Scotland, during which period it will not be legal to fish for or take trout in any lake, river, or loch in Scotland by net, rod, or line, or to have possession of such trout, or expose them for sale. The period proposed for the close time is to begin on October 15, and to end on February 28.

THE King of the Belgians, as Sovereign of the Congo Free State, has contributed 200*l.* towards the establishment of the London School of Tropical Medicine and the enlargement of the Branch Hospital of the Seamen's Hospital Society. The Archbishop of Canterbury has also contributed 50*l.* to the same object. Lord Lister, P.R.S., is to be the principal guest on the occasion of the inaugural dinner in connection with the Liverpool School for the study of tropical diseases on Saturday, April 22. A sum of 1700*l.* has been promised towards the expenses of the Liverpool School.

THE seventy-first meeting of German Naturalists and Physicians will be held at Munich on September 18–23. Prof. Boltzmann, Vienna, will deliver a lecture upon a subject not yet announced; Prof. Förster, Berlin, will describe some of the changes in astronomical thought during the present century; and Dr. Nansen will give an account of explorations of the north polar regions and the results obtained. In medicine, Dr. V. Bergmann, Berlin, will discourse on the value of radiography in surgery; Dr. Birch-Hirschfeld, Leipzig, on science and medicine: and Prof. Dr. Klemperer, Berlin, on Liebig and his influence on medicine. General meetings of the Association will be held on Monday, September 18, and Friday, September 22.

AT a meeting of the general committee of the National Sea Fisheries Protection Association, held on Tuesday, it was resolved: "That representation be made to Her Majesty's Government urging the necessity of telegraphic communication with the Faröe Islands and Iceland, and requesting them to join other Powers in subscribing the amount asked for by the Great Northern Telegraph Company of Copenhagen as an annual subscription for the transmission of meteorological and other Government information; and to appoint a representative to attend the Meteorological Congress to be held in St. Petersburg in August next."

THE third plague epidemic, which has caused the most terrible ravages in Bombay, is, happily, on the decline. Referring to the mortality which has marked its progress, the *Times* states that five weeks ago the populace were dying at the rate of 350 daily. At least 250 of these deaths were due to the plague. During the past week, however, the hot weather has set in steadily, and the plague generally retreats before a sustained high temperature, the decline being immediately noticeable when the thermometer verges upon the nineties. On Monday the mortality fell to 193, of which probably about 100 were plague cases. As to the protective value of inoculation against plague, it is stated that in the town of Hugli 33,000 persons were inoculated with the Haffkine fluid, while 6000 remained uninoculated. In one week there were 371 deaths among the uninoculated, while only 41 occurred among those who had been inoculated. All inoculations were voluntary. The results obtained from Prof. Lustig's curative serum are, however, unfavourably reported upon by the municipal commissioners of Bombay.

WHETHER the pen be mightier than the sword is not for us to discuss at the present moment; but that the camera is mightier than the pen, and follows very closely after the sword, will be conceded when the eye glances over the snap-shots taken during recent campaigns. We learn now that the United States Government is very wide awake as to the advantages of photography for recording events of national or historical interest. According to the *British Journal of Photography* (April 14), the U.S. War Department has undertaken the compilation of a photographic history of the war with Spain. To ensure the thoroughness of the scheme, a circular letter has been addressed to all the officers in the service, asking them to contribute such prints, films or negatives as they may have in their possession, promising to return such loans in good condition. It is further requested that the names of all persons who were known to have carried cameras in the regions of active operations should be communicated, so that their aid might be obtained in completing the record. It is proposed to produce in a single volume every obtainable feature and photograph bearing on the subject; and as it is generally known that the camera was extensively used, the publication of such a volume will be looked forward to with great interest.

Bulletin No. 3 of the Blue Hill Meteorological Observatory contains an account, by Mr. S. P. Fergusson, of the progress of experiments with kites during the years 1897-8, with photographic illustrations of the beginning of an ascent, of the steam power windlass, and of kites carrying meteorograph. In 1884, Mr. D. Archibald succeeded in elevating anemometers to a height of 1500 feet in this country. Mr. W. Eddy devised a simple but efficient kite, about ten years later, which reached a height of about 2000 feet. Since that time the work at Blue Hill, under the able superintendence of Mr. A. L. Rotch, has steadily advanced, until within the last two years the meteorographs have been repeatedly carried to heights exceeding 10,000 feet. The greatest height was reached on February 28 last, viz. 12,507 feet, by means of the Hargrave kite, with improvements by Mr. H. H. Clayton; this pattern being the most stable of those in use, has been adopted in all experiments since the spring of 1897. The vertical height is computed by means of the formula

$$H = (\sin h)\, l x,$$

in which H represents the height; h the angular altitude above the horizon, obtained by observing the kite with a surveyor's transit placed near the windlass; l the length of the line, read from the dial attached to the windlass; and x is a constant quantity determined experimentally as a correction for the sag of the line, &c. This computation is made in about a minute, and the results are accurate within one per cent. Kites are much less expensive than balloons, and the exposure of the instruments is better than can be obtained in manned balloons.

MR. F. NAPIER DENISON has made a special study of the minute undulations recorded upon the self-registering tide gauges, and has compared them with the curves of the self-registering barographs for a number of points on the Atlantic coast of Canada, and within the Gulf of St. Lawrence and the smaller bays. He finds that these minute undulations in the water are due to the direct action of atmospheric waves or billows, or, more properly speaking, oscillations of barometric pressure passing over the harbours and bays. Prof. Cleveland Abbe, the editor of the U.S. *Monthly Weather Review*, suggests that it would be much better to study the barometric oscillations directly as a meteorological problem, and, subsequently, to study their effect on the tides as an oceanic problem; but Mr. Denison recommends the reverse order of treatment. Mr. Denison's last paper appears in the *Proceedings* of the Canadian Institute for November 1898.

A NOTE by Prof. H. V. Hilprecht, in the *Bulletin* (January) of the Free Museum of Science and Art, Philadelphia, states that the new Babylonian expedition of the University of Pennsylvania resumed active work a short time ago. The excavation of the lowest strata of the temple of Bel or Enlil—"the father of the gods"—the exploration of certain quarters of the ancient city proper, and the determination of the precise site of the chief gates of Nippur, form the chief task of the expedition at present. A small number of generous and intelligent citizens of Philadelphia have provided the necessary means for a two years' campaign in Babylonia, with Prof. Hilprecht as scientific director, and Dr. J. H. Haynes as the director of operations in the field. It is hoped that the expedition will settle a number of vital archæological and chronological questions.

AT a meeting of the Royal Statistical Society, held on April 18, Mr. Martineau read a paper on the "Statistical Aspect of the Sugar Question." He began by pointing out that though this question originated some thirty years ago with the bounty on the exportation of refined sugar from France and Holland, it had now been extended to the general consideration of the production of beetroot sugar, both raw and refined, on the continent of Europe, stimulated as it is alleged by bounties. How striking had been the progress of the beetroot industry he showed by comparing the sugar production of the world at intervals during the last quarter of a century. In the first decade the cane sugar production was increased by 266,000 tons, and the beetroot production by 640,000 tons. In the second, cane went up 668,000 tons, and beetroot 1,718,000 tons. In the last five years, up to 1897, cane had decreased 474,000 tons, and beet increased 1,415,000 tons. Among the conclusions drawn from the paper are that cane sugar can be produced cheaper than beetroot; that cane sugar can be profitably produced and sold in this country at a price materially lower than the average price of the last fourteen years of alternate depressions and reactions; and that under free and open competition the world would cease to be dependent on the vicissitudes of the European beetroot crop.

THE issue of *Science* for March 3 contains a paper by Mr. E. D. Preston, Executive Officer to the Superintendent, on the work of the United States Coast and Geodetic Survey. The survey was first authorised in the year 1807, began serious work in 1832, and attained its present permanent status in 1843. Regular work has thus been carried on for over fifty years. Besides the ordinary trigonometrical and astronomical work, covering 350,000 square miles, the Survey has sounded and prepared charts of 164,000 square miles of sea, and has made extensive investigations into hypsometry, magnetism, gravity, and physical hydrography. The measurement of an arc of the ninety-eighth meridian is amongst the works at present in hand, and negotiations are in progress for extending the measurements of certain arcs into Mexico and Canada.

A TRANSLATION of a paper by Prof. Otto Pettersson, originally published in *Ymer*, appears in Nos. 12 and 13 of the current volume of *Die Natur*. An excellent summary is given of the aims and methods of the investigations carried on in the Baltic, the North Sea, and the North Atlantic, by Prof. Pettersson and his colleagues during the last six years, and the application of the results to meteorology, and to the study of fishery questions, is described. The paper is important in view of the proposals for further international co-operation at present under consideration, as it enters more into technical details than was possible in Prof. Pettersson's recent article in the *Nineteenth Century*.

"THE mechanics of the centrifugal machine" is treated very simply by Mr. C. A. Matthey in a paper in the *Transactions* of the Institution of Engineers and Shipbuilders in Scotland. The author, after referring to the great loss of power due to uneven balancing in separators revolving in fixed bearings, points out the superiority of the Weston machine, in which the separator is suspended from above, and its axis kept within limits by india-rubber buffers. The stability of the arrangement is rightly attributed by the author to the imperfect elasticity of the rubber buffers, which by diminishing the precessional motion tends to bring the axis of rotation towards the vertical.

MR. JOSEPH MANNING has written a paper, published by Messrs. Swan Sonnenschein and Co., Ltd., on "The future of the metric and imperial systems of weights, measures and coinage." In it the author advocates a new system of units identical with the metric units but under different nomenclature, and a system of decimal coinage, according to which 1000 farthings would go to the pound. With regard to the former, we fail to see any advantage in using the new names "chor" and "grav" to denote units already known as the "stere" and "tonne," while it hardly seems desirable to use the name "ar" to represent the hundredth part of the metric "are." As further proof of the growth of popular interest in the metric units, we notice that *Science Gossip* for April has lent its pages to a description of the system, contributed by Mr. James Quick.

AT a recent meeting of the Society of Arts, an instructive paper was contributed by Sir Marcus Samuel on liquid fuel, in which an interesting account is given of the difficulties met with in the first attempts made to popularise the use of oil as a fuel. When the oil fields of Dutch Borneo were first opened up, the oil was not allowed to be carried in bulk through the Suez Canal, and there was not a single port in which obstacles were not placed in the way of its introduction. Now vessels carrying 6500 tons, and capable of discharging over 500 tons of oil per hour, pass through the canal regularly, and at ports such as Bombay great facilities are now given for the rapid discharge and distribution of oil cargoes, experience having demonstrated its perfect safety. The advantages claimed for high-flash oil as against coal are convenience of storage, safety, reduction of labour in stoking, and rapidity of discharge. Owing to the regularity with which it can be fed into the furnace, the alternate contraction and expansion of the fire bars and steam tubes, unavoidable when coal is used as fuel, and to which so many boiler accidents can be traced, is altogether stopped, although perhaps the risk of over-heating may be set off against this. Oil fuel is in actual use on the Great Eastern Railway, on railways in the south of Russia, in Paris, Southern California, and in South Africa; it has also been partially adopted in the Russian, German, and Italian navies. The only obstacle to its more general use is the doubt that exists as to whether the price would remain at its present level if the demand were greatly increased.

IN the *Communications* from the Physical Laboratory of the University of Leiden, No. 45, Dr. J. Verschaffelt describes measurements on the system of isothermal lines near the plait-point, and especially on the process of retrograde condensation of a mixture of carbonic acid and hydrogen. The paper is illustrated by two large diagrams representing the isothermals and condensation lines respectively.

MESSRS. TAYLOR, TAYLOR, AND HOBSON have just issued a new catalogue of photographic lenses, containing several noteworthy features. An instructive paper on "The Principles of a Lens Action" is included, and a new form of tables of conjugate foci has been added. In addition to particulars concerning the Cooke portrait lenses, the catalogue now includes the smaller Cooke lenses. A new and neat focussing mount is described, and also the Cooke extension lenses. The catalogue will interest all photographers who see it.

A PAMPHLET on "Ventilation," containing extracts from a paper on "Hospital Construction," recently read by Dr. John W. Hayward before the Liverpool Architectural Society, has been reprinted from the *Builders' Journal and Architectural Record*. The subject is an important one; and the method of ventilation and warming described by Dr. Hayward appears to meet all reasonable requirements.

"THE International Geography," upon which Dr. H. R. Mill has been engaged during the past two years, will shortly be published by Mr. George Newnes. The work is truly international in character, no less than seventy distinguished home and foreign geographers having contributed to it. Each contributor has intimate knowledge of the part of the world with which he deals, and great care has been taken to secure uniformity of plan and method; so that the work will be a concise encyclopædia of geography, suitable alike for reference or as a book for students. Among the authors we notice the names of Dr. D. Aïtoff, Prof. Grenville A. J. Cole, Sir W. Martin Conway, Prof. W. M. Davis, Dr. A. M. W. Downing, Prof. Th. Fischer, Dr. H. O. Forbes, Dr. J. W. Gregory, Prof. A. Heilprin, Sir H. H. Johnston, Dr. Scott Keltie, Prof. A. Kirchhoff, Prof. A. de Lapparent, Sir William Macgregor, Sir Clements Markham, Sir John Murray, Dr. Nansen, Prof. A. Penck, Count Pfeil, the late Sir Lambert Playfair, Prof. L. Raveneau, Sir G. S. Robertson, Dr. Th. Thoroddsen, Sir C. W. Wilson, and many others well known in the scientific world. Judging from the strong and representative list of contributors, the forthcoming work will be a very valuable addition to the literature of geography.

IN two papers recently presented to the American Academy, Prof. Richards, in collaboration with Dr. Cushman and Mr. Baxter, returns to the question of the atomic weights of nickel and cobalt. Both papers bear the stamp of highly accurate and searching work, and, in addition to a discussion of the main question, contain many subsidiary features of interest. Complete analyses of nickelous bromide and cobaltous bromide were undertaken, the salts being reduced by moist hydrogen, and the metals weighed as such. The bromine was determined as silver bromide. The final result for nickel was 58·706, and for cobalt 58·995. As the result of a critical examination of earlier determinations in the case of nickel, the authors select as the most trustworthy the numbers of Zimmermann, 58·694, and of Winkler, corrected by them to 58·69, so that the value 58·70 may be taken as final. As the authors' results for cobalt show less concordance than those for nickel, the extreme values being 58·955 and 59·021, fresh experiments involving different methods are being undertaken. The evidence of all the work is said to strongly support "Winkler's contention that nickel and cobalt, as we knew them of old, cannot contain more than an infinitesimal amount of any unknown element." Several radically different methods of preparation and many fractionations led to atomic weights, constant within a reasonable limit of experimental error. Cobalt has a higher atomic weight than nickel, although this conflicts with the inference to be drawn from the position of rhodium and palladium in the periodic classification. Amongst the minor matters involved in the above investigations the following may be mentioned :—Nickelous bromide and cobaltous bromide, when sublimed in porcelain tubes, are slightly contaminated with sodium bromide. The bromides are more easily reduced by moist than by dry hydrogen ; the metals so prepared do not occlude an appreciable amount of hydrogen, possibly on account of the trace of sodium bromide present. Both nickel and cobalt are acted upon appreciably by water, giving colloidal solutions of the hydrates. This circumstance and also the use of glass apparatus, leading to siliceous residues, account mainly for Krüss's supposed discovery of "gnomium." The colloidal solution of cobaltous oxide absorbs oxygen from the air, and deposits cobaltic hydrate; no such action was observed in the case of nickel.

The additions to the Zoological Society's Gardens during the past week include a Common Badger (*Meles taxus*), British, presented by Mr. Geo. M. Margon-Wilson ; a Silver-backed Fox (*Canis chama*) from South Africa, presented by Mr. C. R. Rennie ; two Black Rats (*Mus rattus*, var.), British, presented by Mr. W. J. Smith ; a Purple-faced Monkey (*Semnopithecus cephalopterus*, ♀) from Ceylon ; a Common Camel (*Camelus dromedarius*, ♂) from Arabia, deposited ; two Black-headed Buntings (*Emberiza melanocephala*), a Puffin (*Fratercula arctica*), European ; two Canada Geese (*Bernicla canadensis*) from North America ; fourteen Golden Carp (*Carassius auratus*) from China, purchased.

OUR ASTRONOMICAL COLUMN.

Tuttle's Comet (1899 *b*).—The following positions are given by Herr J. Rahts in *Ast. Nach.* (Bd. 149, No. 3555) :—

Ephemeris for 12*h*. *Berlin Mean Time.*

1899.	R.A.	Decl.	Br.
	h. m. s.	° ′ ″	
April 20	4 8 26·6	+16 37 42	1·80
21	11 58·1	16 11 14	
22	15 28·9	15 44 31	1·82
23	18 59·0	15 17 34	
24	22 28·5	14 50 24	
25	25 57·4	14 23 1	
26	29 25·7	13 55 24	1·86
27	4 32 53·4	+13 27 35	

The comet should be looked for immediately after sunset ; it travels during the week from between γ and δ Tauri to a position about 2° south of α Tauri (Aldebaran).

Tempel's Comet (1873 II.).—M. L. Schulhof, of the Paris Observatory, gives, in a communication to *Ast. Nach.* (Bd. 149, No. 3554) the calculated elements and ephemeris of this comet, which will arrive at perihelion about the middle of June next.

Elements.

T = 1899, June 18·0 Paris Mean Time.

$$\begin{array}{rcl}
M &=& 352^{\circ}\ 26'\ 22''{\cdot}9 \\
\begin{array}{r}\pi\\ \Omega\\ i\end{array} & \begin{array}{c}=\\=\\=\end{array} & \left.\begin{array}{r}306\ 33\ 51{\cdot}5\\120\ 57\ 57{\cdot}0\\12\ 38\ 56{\cdot}2\end{array}\right\}1899{\cdot}0 \\
\phi &=& 32\ 49\ 41{\cdot}2 \\
\mu &=& 671''{\cdot}8846 \\
\log a &=& 0{\cdot}481808
\end{array}$$

Ephemeris for 12*h*. *Paris Mean Time.*

1899.	R.A.	Decl.	Br.
	h. m. s.	° ′ ″	
April 20	18 24 29·3	− 5 36 9	0·285
21	26 16·0	5 31 27	
22	28 2·4	5 36 44	0·317
23	29 48·5	5 32 2	
24	31 34·4	5 27 20	
25	33 20·0	5 22 39	
26	35 5·4	5 18 0	0·358
27	18 36 50·4	− 5 13 22	

The brightness in 1878 was 0·113, while during the apparition of 1894 it was 0·190, so that the present return should be much easier of observation. The comet will be travelling from the south-eastern border of Ophiuchus, through Scutum Sobieski, into Aquila, and search should be made in the early morning.

Variable Star Notes.—The fourth pamphlet issued from the Rousdon Observatory of Sir C. E. Peek, at Lyme Regis, South Devon, contains the individual observations of the variables R and χ Cygni, extending over the period 1887 January 20 to 1896 December 23. The resulting estimates of magnitude are also plotted out at the end of the pamphlet showing the light-curves, from an examination of which it appears that the period of χ Cygni is something over 14 months, and that of R Cygni about 12·5 months.

Spectrum of Saturn's Rings.—Prof. Vogel many years ago stated that he had observed a strong absorption band in the red region of the spectrum of Saturn, at λ 6183, which was extremely faint or absent in the spectrum of the rings. Prof. Keeler in 1889 could detect no trace of it in the ring spectrum, using the 36-inch Lick refractor. During the evening of August 18, 1898, Mr. Ellerman, of the Yerkes Observatory, photographed the spectrum of Saturn on an isochromatic plate very sensitive to the red region, using the 40-inch telescope. The spectroscope used had one flint prism of 60° angle, the collimator and camera lenses being 1·4 inches aperture and 19 inches and 10½ inches focus respectively. The planet being far south the exposure had to be short, so the slit had to be used fairly wide. A reproduction of an enlargement (7·5 times) from this negative is given in *Astrophysical Journal* for March (vol. ix. p. 186). The absorption band referred to is very readily seen in the spectrum of the ball of the planet, but no trace of it is at all visible in the ring spectra. The conclusion drawn by Prof. Hale from this fact is that the rings possess little or no atmosphere, thus confirming the result formerly obtained from visual observations.

The Sun's Mean Temperature.—In our last issue we called attention to a criticism of Dr. See's article on "The Sun's Heat," by Dr. A. S. Chessin, in the *Astronomical Journal*, No. 456. In the current issue, No. 458, there are some further remarks by Prof. S. Newcomb and Dr. Chessin, which we give below.

Prof. Newcomb writes : "Dr. Chessin's remark in *A. J.*, 456, does not seem to me well founded. The problem is this : The parts of a spherical gaseous mass A are kept in equilibrium between the force of their mutual gravitation, and of their elasticity due to temperature. To preserve this equilibrium let there be an absolute temperature T_0, which may increase from the surface to the centre. Now, by the radiation of heat, let the radius of the mass A contract from R_0 to R. What is the temperature T necessary to maintain the equilibrium of the mass after contraction ? The formula given by See,

$$T = \frac{R_0 T_0}{R},$$